KNOWLEDGE OF DENTISTS ABOUT ANTIBIOTICS PRESCRIPTIONS FOR ORAL AND DENTAL TREATMENT IN NORTH OF JORDAN

by

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(وَقُل رّبِ زِدنِي عِلماً)

الآية (١١٤) من سورة طه (٢٠)

“And Say O My Lord, Increase me in knowledge.”
(Sura Ta’ha, S.20/V.114)

DEDICATION

This dissertation is dedicated to my grateful parents, who have help me through my life and they make all the efforts to build me up in my scientific and personal aspect. This is the smallest gift I can give to them for their unconditional love, encouragement, guidance, trust, and support. Daddy and mommy you are my silent inspiration.

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ABSTRACT

KNOWLEDGE OF DENTISTS ABOUT ANTIBIOTICS PRESCRIPTIONS FOR ORAL AND DENTAL TREATMENT IN NORTH OF JORDAN

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Statement of problem: The antibiotics use has been increased dramatically in all areas of dentistry over the last decayed.

Aim: The aim of the current study was to assess the pattern of use of antibiotics by dentists in North of Jordan.

Materials and Methods: A Simple modified questionnaire was distributed by hand to 174 dentists practicing in Irbid. It included questions about socio-demographics, some clinical signs that might imply the use of antibiotics, non-clinical criteria for which respondents may give antibiotics, some dental problems treated by the dentists, occurrence of systemic diseases that might imply the use of antibiotics, and the last part concerned about endocarditis.

Results: Of the 134 (77%) dentists, who completed the questionnaire, 75% were male, half of them were 30 years of age or less, and 40% were graduated from Jordanian universities. 64% of the respondents prescribed antibiotics for pyrexia. About 89% of the respondents would prescribe antibiotics for gross diffuse swelling whereas 73% of them would prescribe antibiotic for localized fluctuant swelling. For difficulty in opening mouth, 59.3% of the respondents would prescribe antibiotics. Of all respondents, 56.1% and 72.7% would prescribe antibiotics for patients with difficulty in swallowing and periorbital swelling respectively. For cellulites, surgical extraction, ANUG, sinusitis, periodontal abscess, and apicectomy the proportion of respondents who would prescribe antibiotics was 93.6%, 86.4%, 81.3%, 80.9%, 79.1%, 72.8% respectively. As prophylaxis, 98.2% prescribe antibiotics for patient with artificial heart valve, and 88% prescribe antibiotic to prevent post operative complication. Amoxicillin was the most common antibiotic used.

Conclusions: Antibiotics are widely prescribed by dentist in routine dental treatment. There is a lack of uniformity in prescription of antibiotics.

Clinical implications: Guidelines for appropriate use of antibiotics in dentistry should to be developed.

Chapter One: Introduction

1.1. Background:

The oral cavity is the first part of the gastrointestinal tract. In addition, it opens with the nose in the respiratory system. The mouth is a rich media of microorganisms, which enter via food and air passing through.[1] Microorganism is defined as living form that can't be seen without the microscope, and include algae, bacteria, fungi, protozoa, and viruses.[2,3] The oral cavity has a number of features that makes it a distinct microbial habitat. The various surfaces in the oral cavity are continuously bathed with saliva and they represent different ecological niches in which distinct inhabitants exist within this complex environment. The ecological characteristics of the different surfaces found in the oral cavity, each with different key ecological factors such as adhesion ligands, pH, nutrients, redox potential, oxygen tension, and temperature, make it a unique microbial habitat in the human body.[4] The composition of microorganisms in the oral cavity is complex and such complicity was noticed in as early as 1683 by Antonie van Leeuwenhoek.[5]

The oral microorganism is composed predominantly of bacteria, but fungi, viruses, mycoplasmas, and even protozoa and archaea can be found. It is estimated that more than 700 cultivable and noncultivable species are present in the oral cavity.[6] Over 400 of the 700 oral species have been identified from the periodontal pocket and 300 species from other locations in the oral cavity.[2,7] Any particular individual is thought to have approximately 100–200 of these 700 species and is thought to harbor around 50 species in the periodontal pocket.[7]

As the oral cavity is colonized by a diverse range of microorganisms, it is more susceptible to infection. Dental caries is an infectious disease of a bacterial origin result in localized dissolution of tooth structure.[8-10] Together with periodontal disease, are considered the most common oral diseases.[9,11]

Infection is an invasion of any body tissue by pathogenic microorganism(s) and its multiplication in the tissue, including bacteria, viruses, fungi and parasites.[3,12] Some infections may be cured spontaneously in a period of time. However, others should be treated as they might spread to other tissues of the body and cause severe illness, and in some cases they even might become fatal.[13] Thus physicians and dentists use antibiotics in order to eliminate these infections.[12]

1.2. Antibiotics and Antimicrobials:

The word antimicrobials originally described a substance, such as penicillin or cephalosporin, produced by or derived mostly from certain fungi, bacteria, and other organisms, that can directly kill or inhibit the growth of other microorganisms. Later, these substances were replaced by synthetic or semisynthetic derivatives that were designated antibiotics or antimicrobial agents to distinguish them from the former.

However, nowadays, the term antibiotic is often used informally for a drug that according to this definition is an antimicrobial. In the present thesis, both terms will be used synonymously for antibacterial agents.

1.2.1. Antibiotics in Dental Practice

It is well known that periodontitis and dental caries are dental biofilm-mediated diseases.[5,14] Therefore, reduction of dental biofilm accumulation is regarded a premium goal in controlling these diseases. This is achieved mainly by patient's oral hygiene efforts with regular professional help by dental hygienists. Systemic antibiotic therapy has no effect on reducing supragingival plaque accumulation and solely dedicating them to control the dental plaque-mediated periodontal diseases is not an appropriate practice.[15] Mechanical debridement of dental biofilm alone is usually, but not always, sufficient for the control of these diseases. Therefore, chemotherapy is sometimes needed to aid the mechanical debridement.

Dental practitioners, by law, have the right to prescribe a battery of antibiotics in dental practice. In general, antibiotic prescribing in dental clinics are justified as:

1. Therapeutic aid to surgical treatment of an acute or chronic infection.[16,17]
2. Therapeutic to treat active infectious disease, for example, acute ulcerative gingivitis.[16,17]
3. Prophylactic to prevent metastatic infection, such as bacterial endocarditis.[18-23]

Prophylaxis in medically compromised patients (MCPs), who receive dental treatment, is not always a clear-cut matter, because different guidelines may have different recommendations and various regimens exist.[24-27] Furthermore, these guidelines are always under revision and, therefore, dentists are required to update themselves regularly. Just recently, the American Heart Association (AHA) recommends that some patients who have taken prophylactic antibiotics routinely in the past are no longer in need of prophylactic antibiotics as a preventive measure before their dental treatment.[27]

The usage of the antibiotics has been increased dramatically in dentistry over the last decayed.[28] Also, studies of the need for and the effectiveness of antibiotics in the dental field continue, there is an ongoing debate over their role in prophylaxis.[22] The empiric and broad use of antibiotic prophylaxis is clearly no longer acceptable, but details regarding responsible prescribing remain problematic. In the dental community, there has been a general trend toward overprescribing.[29-31] One survey found that only 39% of dentists followed guidelines appropriately.[32] Many practitioners rely on recommendations of other practitioners, who often cite anecdotal evidence, or decide that, when in doubt, the wise and conservative course is to prescribe.[23]

Palmer *et al.* (2000)[30] found that prescribing of antibiotics with in National Health Services (NHS) dental practice can be sub-optimal, with considerable variation from the recommended frequencies and doses. In UK 1998 dental practitioners prescribed 7% of all antibiotic drugs this may not seen much; nevertheless, dentist dispensed 3.3 million prescriptions for antibiotic drugs in 1993, 3.5 million prescriptions in 1996 with cost of £4.5 million[33], and more than this number where observed in 1997. Prescriptions for antibiotic where dispensed by GDPs at a net ingredient cost of £5.2 million.[33] In a report in 2000, antibiotic drugs cost the USA about $15 billion per year. $1.3 billion the cost associated with drugs resistance.[34] In 2004 the British Dental Association, stated that dentist use to prescribe antibiotics on an average of 3 prescriptions per week, and this imply a greater antibiotic usage by dentist than might be thought initially if take in consideration that 22,000 dentist are practicing in UK at that time. [1,35,36] Inappropriate prescription of antibiotics by dentists could play a significant role in emerging of microorganisms' resistance.[35,37] Such a misuse includes incorrect dose and duration of antibiotic therapy, incorrect choice of appropriate antibiotic, and the use of it in

unwarranted clinical situations. The rising of microbial resistance to antibiotics is an increasingly important public health issue.[33] It become more serious through out the world, especially in the developing countries, where antibiotic drugs are excessively prescribed, or are available without prescription.[33]

There are limited studies surveying antibiotics prescribed by the dentist.[9,15,29-31,38,39] These studies were showned wide variation in prescription and dosages.[37]

Chapter Two: Aims and significance

2.1. Study Aims:

The aim of the current study was to assess the pattern of antibiotics used by dentists in the North of Jordan.

2.2. Significance of the Study:

Antibiotic use in dental health systems have been investigated in various studies.[28,35,36] The fact that dental practitioners prescribe antibiotics for their patients irrespective of the need for such prescription is contradictory. The investigators hypothesized that there is an abuse of antibiotics in developing country, therefore, decided to investigate the situation in Northern Jordan. This study provides a focused look at the status of antibiotic prescription among dental practitioners in the North of Jordan. The understanding level of awareness about antibiotic use in dental health practices is essential in providing a firm baseline for appropriate prescription.

Chapter Three: Review of Literature

3.1. Normal Flora of the Oral Cavity:

Normal flora is the microorganism that usually populate the outer and internal surfaces of the human body. They are commensal, don't harm their host, and may be sometimes helpful.[3] It has been estimated that there is about 100 trillion microbes live on and within our bodies, and it composed of between 500 and 1000 different species,[3,17] see [Table 3.1] for further details.

Table 3.1: The normal flora of the human body distributed in site of presence.[3]

Site	Common normal flora
Skin	***Staphylococci, streptococci, corynebacteria (diphtheroids), Candida***
Throat	***α-haemolytic streptococci, neisseria, corynebacteria (diphtheroids)***
Mouth	***α -haemolytic streptococci, moraxella, actinomyces, spirochaetes***
Respiratory tract	***α-haemolytic streptococci, moraxella, corynebacteria (diphtheroids), micrococci***
Vagina	***Lactobacilli, corynebacteria (diphtheroids), streptococci, yeasts***
Intestines	***Bacteroides, anaerobic streptococci, enterococci, clostridrium, E. coli, klebsiella, proteus***

It is estimated that more than 700 cultivable and noncultivable species are present in the oral cavity.[6] Over 400 of the 700 oral species have been identified from the periodontal pocket and 300 species from other locations in the oral cavity.[2,7] Any particular individual is thought to have approximately 100–200 of these 700 species and is thought to harbor around 50 species in the periodontal pocket.[7]

Several Gram-positive and Gram-negative bacterial genera are found in the normal flora of the oral cavity. Among the Gram-positive ones are *Enterococcus*, *Peptostreptococcus*, *Streptococcus*, *Staphylococcus*, *Actinomyces*, *Corynebacterium*, *Eubacterium*, and *Lactobacillus* species, whereas *Aggregatibacter* (formerly *Actinobacillus*), *Haemophilus*, *Bacteroides*, *Campylobacter*, *Leptotrichia*, *Prophyromonas*, *Capnocytophaga*, *Prevotella*, *Tannerella*, *Eikenella*, *Treponema*, *Fusobacterium*, and *Wolinella* species are among the Gram-negative ones.[4]

Adhesion of bacteria species to oral surfaces is the initial event in their establishment as a distinct microbial community in different niches within the oral cavity. The initial adhesion is characterized by the presence of the same bacterial species that later on may modify the surrounding environment, making it suitable for other species to colonize.[4]

Despite the diverse community of microorganisms found within the oral cavity, it is characterized by a high degree of stability. Such a stable community is referred to as climax community.[4] It is maintained in spite of host defense and modest environmental stress, such as, changes in saliva flow, diets, regular exposure to mouth rinses and tooth pastes, challenge by exogenous species, and exposure to antibiotics. This stability, referred to as microbial homeostasis, is of great importance to oral health as it insures that potentially harmful species remain in low numbers.[4] Major environmental perturbations, such as pH or redox potential changes, are necessary to break the microbial homeostasis, resulting in deteriorated oral health and development of diseases, such as periodontitis and dental caries.[40]

3.2. Oral and Dental Infections:

Coaggregation is the physical interaction between bacteria of different species. It is not random among oral bacteria; each species binds specifically to other bacteria. The diverse community of microorganisms found on a tooth surface is known as dental plaque. It is defined clinically as the soft, tenacious deposit that forms on tooth surfaces that is not readily removed by rinsing with water.[41] Microbiologically, it can be defined as the diverse community of microorganisms found on a tooth surface as a biofilm, embedded in an extracellular matrix of polymers of host, and is of microbial origin.[42] Recently, the classical name of bacterial deposits on tooth surfaces known as "dental plaque" is increasingly substituted by the more appropriate name "dental biofilm".[9] According to its location, dental biofilm can be found supragingivally or subgingivally. The general properties of a biofilm make the involved microorganisms dramatically different from their planktonic counterparts, that is, bacteria that are suspended or growing in a fluid. Such properties include open architecture, protection from host defenses, enhanced resistance to antibiotics, neutralization of inhibitors, novel gene expression, coordinated gene responses, spatial and environmental heterogeneity, broader habitat range, and more efficient metabolism.[42]

It is well known that periodontal diseases [43] and dental caries, the most prevalent microbial diseases in humans, are dental biofilm-mediated diseases.[5,14,44,45]

There has been an ongoing controversy as to which bacteria or bacterial species within the dental biofilm are involved in the causation of these diseases.[44,45] The issue is even more complicated in the case of periodontal diseases, principally because these diseases occurs at sites with a preexisting complex normal flora, making discrimination of opportunistic

pathogens from host-compatible species a real challenge, especially the fact that the pathogens may be carried in low numbers in a healthy oral cavity.[46,47] In addition, periodontal infections seem to be mixed in nature, involving more than one bacterial species, rendering evaluation of the etiology of periodontitis a difficult task. For this and others reasons, Koch's postulates have been replaced by a set of criteria to define periodontal pathogens. These criteria include (1) association (the species is found more frequently and at higher levels in disease compared to health), (2) elimination (elimination of the species is paralleled by remission of disease), (3) host response (presence of immune response against that species), (4) possession of virulence factors, and (5) induction of disease in animals.[46] These criteria assisted researches in pointing out some candidates as etiological agents of periodontal diseases. In light of these criteria, there was a strong evidence to support a consensus implicating *Porphyromonas gingivalis* and *Tannerella forsythia* as etiological agents of chronic periodontitis, and *Aggregatibacter actinomycetemcomitans* as that of aggressive periodontitis.[48]

It is well known that in dental biofilm, certain bacteria often cluster together and if one member of a particular cluster is detected in a sample, other members of that cluster are also most likely to be detected,[49] indicating that these bacteria prefer similar living environment. There are five microbial complexes described, namely, red, orange, yellow, purple, and green complexes, in subgingival plaque.[49] The red complex is composed of *P. gingivalis*, *T. forsythia* and *Treponema denticola*, and it is strongly associated with the clinical signs of chronic periodontitis, whereas bacteria of the genera *Fusobacterium*, *Prevotella*, *Peptostreptococcus*, *Eubacterium*, and *Campylobacter*, which are members of the orange complex, are moderately associated with the disease.

3.3. Antibiotics and Antimicrobials:

It is defined as any chemical drug used to treat an infectious disease, either by inhibiting or killing pathogens in vivo. Some antimicrobials agents are antibiotics. By definition, an antibiotic is a substances produced by a microorganism and have the capability of destroying bacteria, suppressing its growth or multiplication, or prevent their action.[12,17] Antibiotic are either bactericidal (capable of killing bacteria in an irreversible action), or bacteriostatic (causing inhibition or retardation in growth or multiplication of bacteria in a reversible fashion).[2,28,35]

The first antibiotic, penicillin, was discovered in 1928 by Sir Alexander Fleming. Ten years after the Fleming's discovery of penicillin, sulfonamide was discovered, and as time passed, new drug discoveries led to an explosive development of numerous antibiotics from the 1950s till the early 1990s. It was not surprising that shortly after numerous antibiotic discoveries that were active against both Gram-positive and Gram-negative bacteria, surgeons believed at that time that the ongoing ancient fight between human and infectious diseases was becoming to an end.

3.3.1. Classification of Antibiotics:

Numerous classifications of antibiotics had be proposed and used. They can be classified according to their inhibition of the microorganisms. Bactericidal agents, which kill bacteria; and bacteriostatic agents, which inhibit multiplication without actually killing the pathogen.[21] however, the distinction is rather hazy and is dependent on factors such as the: (1) Concentration of the drug (e.g. erythromycin is bacteriostatic al low concentrations and bactericidal at high concentrations); (2) Pathogen in question; and (3) Severity of infection.

Furthermore, host defense mechanisms play a major role in eradication of pathogens from the body and it is not essential to use bactericidal drugs to treat most infections. A bacteriostatic drug which arrests the multiplication of pathogens and so trips the balance in favor of the host defense mechanisms is satisfactory in many situations.

Another classification of antibiotics can be according to the strains of bacteria they affect. Other classification methods include the classification of antibiotics according to their chemical structure. Examples to this are penicillins, cephalosporins, aminoglycosides, tetracycline, macrolides, or sulfonamides, among other types of antibtiocs.[28]

Moreover, antibiotics can be classified according mode of action.[21] Antimicrobial agents inhibit the growth of or kill microorganisms by a variety of mechanisms. In general, however, one or more of the following target sites are involved: (1) Cell wall; (2) Cytoplasmic membrane; (3) Ribosomes; and (4) Nucleic acid replication sites.[21,36] A summary of the mode of action commonly used antibiotics is given in Table 3.2.

Table 3.2: Cellular target sites of antibiotics commonly used in dentistry.

Target Site	Drug	Cidal / static	Comments
Cell wall	ß-Lactames, e.g. penicillin, ampicillin, cephalosporin, cloxacillin.	Cidal	Interfere with cross-linking of cell wall molecules
	Bacitracin (topical)	Cidal	Inhibit peptidoglycan formation
Ribosomes	Erythromycin Fusidic acid (topical)	Static[†] or cidal[‡]	Interfere with translocation, thus inhibting protein synthesis
	Tetracycline	Static	Interferes with attachment of transfer RNA, thus inhibiting protein synthesis
Cytomplasmic membrane	Polyenes, e.g. nystatin, amphotericin	Static	Disrupts yeast cell membrane
Nucleic acid replication	Metranidazole	Cidal	Interferes with DNA replication
	Idoxuridine Acyclovir	Cidal	Interfere with DNA synthesis in DNA viruses

[†]Low concentration, [‡]High concentration

3.3.2. Antibiotics in Dental Practice

It is well known that periodontitis and dental caries are dental biofilm-mediated diseases.[5,14] Therefore, reduction of dental biofilm accumulation is regarded a premium goal in controlling these diseases. This is achieved mainly by patient's oral hygiene efforts with regular professional help by dental hygienists. Systemic antibiotic therapy has no effect on reducing supragingival plaque accumulation and solely dedicating them to control the dental plaque-mediated periodontal diseases is not an appropriate practice.[15] Mechanical debridement of dental biofilm alone is usually, but not always, sufficient for the control of these diseases. Therefore, chemotherapy is sometimes needed to aid the mechanical debridement.

3.3.3. General Indications of Antibiotics in Dentistry:

Antibiotics should be prescribed on a rational clinical and a microbial basis.[21] Clinical signs and symptoms of active infections include fever, tachycardia, facial swelling, limited mouth opening, difficulty in swallowing, spreading infection without localization, chronic infection despite drainage or debridment and regional lymphadenitis. Single or combined drug therapies have gained increasing importance in dental practice, but, whenever possible, single drug therapy should be prescribed to reduce incidence of side effects, emergence of resistance, and the cost of therapy.[1,23]

Antibiotic prescription should be based on microbiological testing for the following clinical diagnosis: aggressive periodontitis, generalized severe chronic periodontitis, periodontitis exhibiting progressive attachment loss despite thorough adequate treatment, and severe periodontitis associated with systemic diseases, for example, human immunodeficiency virus.[50] Reports show that many antibiotic classes are utilized by dentists.[9,15,29-31,38,39] For empiric therapy, that is, the proper selection of which antibiotic to prescribe for patients, the dentists should consider the pharmacological characteristic of the antibiotic, the patient's safety, the probable infectious agent, and the cost of the drug.

3.3.3.1. Prevention of infective endocarditis:

Infective endocarditis (IE) is an uncommon but life-threatening infection. Despite advances in diagnosis, antibiotic therapy, surgical techniques and management of complications, patients with IE still have substantial morbidity and mortality related to this condition. Since the last American Heart Association (AHA) publication on prevention of IE in 1997,[51] many authorities, societies and the conclusions of published studies have

questioned the efficacy of antibiotic prophylaxis to prevent IE in patients who undergo a dental procedure and have suggested that the AHA guidelines should be revised.[44,45]

Table 3.3: Summary of nine iterations of American Heart Association recommended antibiotic regimens from 1955 to 1997 for dental procedures.

Year	Primary regimens for dental procedures*
1955[52]	Aqueous penicillin 600,000 units IM[†] and procaine penicillin in oil containing 2 percent aluminum monostearate 600,000 U IM administered 30 minutes before the operative procedure.
1957[53]	For two days before surgery, penicillin 200,000 to 250,000 U by mouth four times per day. On day of surgery, penicillin 200,000 to 250,000 U by mouth four times per day and aqueous penicillin 600,000 U with procaine penicillin 600,000 U IM 30 to 60 minutes before surgery. For two days after, 200,000 to 250,000 U by mouth four times per day.
1960[54]	Step I: prophylaxis two days before surgery with procaine penicillin 600,000 U IM on each day. Step II: day of surgery: procaine penicillin 600,000 U IM supplemented by crystalline penicillin 600,000 U IM one hour before surgical procedure. Step III: for two days after surgery: procaine penicillin 600,000 U IM each day.
1965[55]	Day of procedure: Procaine penicillin 600,000 U, supplemented by crystalline penicillin 600,000 U IM one to two hours before the procedure. For two days after procedure: procaine penicillin 600,000 U IM each day.
1972[56]	Procaine penicillin G 600,000 U mixed with crystalline penicillin G 200,000 U IM one hour before procedure and once daily for the two days after the procedure.
1977[57]	Aqueous crystalline penicillin G 1,000,000 U IM mixed with procaine penicillin G 600,000 U IM. Give 30 minutes to one hour before procedure and then give penicillin V 500 milligrams orally every two hours for eight doses.
1984[58]	Penicillin V 2 grams orally one hour before; then 1 g six hours after initial dose.
1990[59]	Amoxicillin 3 g orally one hour before procedure; then 1.5 g six hours after initial dose.
1997[51]	Amoxicillin 2 g orally one hour before procedure.
2008[27]	Amoxicillin 2 g orally half to one hour before procedure, or within 2 hour after procedure.

* These regimens were for adults and represented the initial regimen listed in each version of the recommendations. In some versions, more than one regimen was included.
[†] IM: Intramuscularly.

There are no prospective randomized placebo-controlled studies on the efficacy of antibiotic prophylaxis to prevent IE in patients who undergo a dental procedure.[27] Data from published retrospective or prospective case-control studies are limited by the

following factors: (1) the low incidence of IE, which requires a large number of patients per cohort for statistical significance; (2) the wide variation in the types and severity of underlying cardiac conditions, which would require a large number of patients with specific matched control subjects for each cardiac condition; and (3) the large variety of invasive dental procedures and dental disease states, which would be difficult to standardize for control groups. These and other limitations complicate the interpretation of the results of published studies of the efficacy of IE prophylaxis in patients who undergo dental procedures.[27]

Although some retrospective studies suggested that there was a benefit from prophylaxis, these studies were small and reported insufficient clinical data. Furthermore, in a number of cases, the incubation period between the dental procedure and the onset of symptoms of IE was prolonged.[60-62] van der Meer et al. (1992)[63] performed a two-year case-control study. Among patients for whom prophylaxis was recommended, five of 20 cases of IE occurred despite receiving antibiotic prophylaxis. They concluded that prophylaxis was not effective. In a separate study, van der Meer et al. (1992)[64] reported that there was poor awareness of recommendations for prophylaxis among both patients and health care providers. Helpin et al. (1998)[65] made a prospective study of 14 children with ventriculo-peritoneal shunts who had dental scaling and polishing procedures without antibiotic prophylaxis, none of whom developed infection. Given its nonrandomized nature and small size, this study provides no support for or rationale against prophylaxis. The argument for antibiotic prophylaxis before dental procedures is based on the incidence of shunt infections in general and their potentially devastating consequences, rather than on scientific data regarding efficacy.[66]

The vast majority of cases of IE caused by oral micro-flora most likely result from random bacteremias caused by routine daily activities, such as chewing food, tooth brushing, flossing, use of toothpicks, use of water irrigation devices and other activities. The presence of dental disease may increase the risk of bacteremia associated with these routine activities. There should be a shift in emphasis away from a focus on a dental procedure and antibiotic prophylaxis toward a greater emphasis on improved access to dental care and oral health in patients with underlying cardiac conditions associated with the highest risk of adverse outcome from IE and those conditions that predispose to the acquisition of IE.[27]

The studies are in agreement with a recently published French study[67] of the estimated risk of IE in adults with predisposing cardiac conditions who underwent dental procedures with or without antibiotic prophylaxis.[68] These authors concluded that a "huge number of prophylaxis doses would be necessary to prevent a very low number of IE cases."

The American Heart Association (AHA) recommends that some patients who have taken prophylactic antibiotics routinely in the past are no longer in need of prophylactic antibiotics as a preventive measure before their dental treatment. This includes patients with mitral valve prolapse, rheumatic heart disease, bicuspid valve disease, calcified aortic stenosis, and congenital heart conditions such as ventricular septal defect, atrial septal defect, and hypertrophic cardiomyopathy.[27]

According to the latest AHA recommendations, prophylactic antibiotics are recommended in all dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa made on patients with cardiac conditions that

associated with the highest risk of adverse outcome from endocarditis for which prophylaxis with dental procedures is reasonable are: (1) Prosthetic cardiac valve or prosthetic material used for cardiac valve repair; (2) Previous infective endocarditis; (3) Congenital heart disease (CHD); (4) Unrepaired cyanotic CHD, including palliative shunts and conduits; (5) Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first six months after the procedure; (6) Repaired CHD with residual defects; (7) Cardiac transplantation recipients who develop cardiac valvulopathy.[27] Although IE prophylaxis is reasonable for these patients, its effectiveness is unknown.[27]

However, other dental procedures and events do not need prophylaxis like, (1) routine anesthetic injections through noninfected tissue; (2) taking dental radiographs; (3) placement of removable prosthodontic or orthodontic appliances; (4) adjustment of orthodontic appliances; (5) placement of orthodontic brackets; (6) shedding of primary teeth; (7) bleeding from trauma to the lips or oral mucosa.

Prabhu et al. (2004)[69] studied susceptibility patterns of viridans group streptococci recovered from patients with IE diagnosed during a period from 1971 to 1986 and compared these susceptibilities with those of viridans group streptococci from patients with IE diagnosed from 1994 to 2002. In this study, none of the strains of viridans group streptococci were penicillin-resistant in the early period, compared with 13 percent of strains that were intermediate or fully penicillinresistant during the later period. In this study, macrolide resistance increased from 11 to 26 percent and clindamycin resistance from 0 to 4 percent.

Table 3.4: The recommended antibiotics prophylactic regimens by AHA for a dental procedure.

Situation	Agent	Regimen: single dose 30-60 minutes before procedure	
		Adults	Children
Oral.	Amoxicillin	2 grams	50 milligrams/kg
Unable to take oral medication.	Ampicillin or	2 g IM[*] or IV[†]	50 mg/kg
	Cefazolin or	1 g IM or IV	50 mg/kg
	Ceftriaxone	1 g IM or IV	50 mg/kg
Allergic to Penicillins or Ampicillin Oral	Cephalexin[‡§] or	2 g	50 mg/kg
	Clindamycin or	600 mg	20 mg/kg
	Azithromycin or	500 mg	15 mg/kg
	Clarithromycin	500 mg	15 mg/kg
Allergic to Penicillins or Ampicillin and Unable to take Oral Medication	Cefazolin or	1 g IM or IV	50 mg/kg
	Ceftriaxone§ or	1 g IM or IV	50 mg/kg
	Clindamycin	600 mg IM or IV	20 mg/kg

[*] IM: Intramuscular; [†] IV: Intravenous; [‡] Or other first- or second-generation oral cephalosporin in equivalent adult or pediatric dosage; § not in a person with a history of anaphylaxis, angioedema or urticaria with penicillins or ampicillin.

3.3.3.1.1. Heart Valve Disease and Prosthetic Heart Valves:

Formal recommendations from the AHA concerning antibiotic prophylaxis for patients who have cardiac conditions and are undergoing invasive procedures go back more than 50 years,[70] and virtually all professional association guidelines, textbooks and journal articles quote these recommendations.[51] Dental procedures always have been the central focus of the issue of antibiotic prophylaxis, but there never has been a prospective clinical trial for efficacy. These recommendations came into being and have been sustained for several reasons: (1) The focal infection theory, which was particularly popular in North America in the first one third of the 20th century;[71] (2) The almost universal mortality resulting from IE in the preantibiotic era; (3) Early animal studies attempting to replicate IE in humans; (4) The high incidence of viridans group streptococci (VGS) as a cause of IE and the high frequency of VGS bacteremia after dental office procedures; (5) Hundreds of poorly documented case reports implicating dental procedures, none of which demonstrate a

causal relationship; (6) An exaggerated temporal relationship between an invasive procedure and the onset of symptoms of IE.[70]

It is estimated that about 85,000 mechanical heart valves are placed annually in the United States and that about 3,400 (4 percent) will become infected, at an average cost of about $50,000 per occurrence.[72] Although the prognosis for patients with IE has improved dramatically in the antibiotic era, it is associated with a high morbidity and mortality for some cardiac patients.[73]

The early focus of journal articles and textbook chapters on dental office procedures as a cause of IE continues today, both with and without an emphasis on dental disease and poor oral hygiene.[74,75] There have been conflicting results from efforts to assess the evidence that dental extractions can cause IE, that prophylaxis is cost-effective[76] and that antibiotics are effective in preventing IE. Epidemiologic and cost-benefit analysis evidence is mounting to suggest that this practice should be eliminated, except perhaps for a select group of patients with cardiac conditions who are felt to be at greatest risk of experiencing a bad outcome from IE.[77]

Some retrospective studies suggest that prophylaxis provides some benefit, but they are of small size, often with inadequate clinical data and methodology.[61] There were no randomized studies and only one case-controlled study, which included patients with native or prosthetic cardiac valves who had had a dental procedure as long as 180 days before the onset of symptoms of IE.[63] van der Meer et al. (1992)[78] concluded that dental or other procedures probably caused only a small fraction of cases of IE and that prophylaxis would prevent only a small number of cases even if it were 100 percent effective.[62,68]

Strom et al. (1998)[77] evaluated dental prophylaxis and cardiac risk factors in a multicenter case-control study. These authors reported that mitral valve prolapse (MVP), congenital heart disease (CHD), rheumatic heart disease (RHD) and previous cardiac valve surgery were risk factors for the development of IE. The control subjects (without IE) were more likely to have undergone a dental procedure than patients with IE (P = .03). They concluded that dental treatment was not a risk factor for IE even in patients with valvular heart disease and that few cases of IE could be prevented with prophylaxis even if it were 100 percent effective.

Although formal guidelines exist, so do controversy and confusion concerning this practice.

3.3.4. Antibiotics Commonly Used in Dental Practice

Most oral infections are poly microbial because of involvement of Gram-positives and Gram-negatives of both anaerobes and aerobic bacteria. In the following section, a description of the most prescribed antibiotics in dental practice is given. This is far from being a comprehensive reference of these antibiotics, but may serve as a general overview of these agents.

3.3.4.1. ß-Lactam Antibiotics:

Although, Sir Alexander Fleming discovered the penicillin in 1928, the mass production of this antibiotic actually began from 1939 when a joint effort was made by Great Britain, Canada, and the United States to mass produce penicillin for the alliance troops.[1] A wide array of penicillins and other ß-lactams antibiotics have been synthesized by incorporating

various side chains into the ß-lactam ring. Of all ß-lactams antibiotics, penicillins are the most widely used antibiotics in dentistry.[1]

The narrow-spectrum penicillinase-sensitive agents, such as penicillin G and penicillin V, and the broad-spectrum aminopenicillins, for example, ampicillin and amoxicillin, are of primary interest to dental practitioners. Penicillin V, phenoxymethylpenicillin, is orally administered and it is active against streptococci and most oral anaerobes.[79] Phenoxymethylpenicillin is effective against a majority of *α-haemolytic streptococci* and *penicillinase*-negative *staphylococci*. Aerobic Gram-positive organisms, including *Actinomyces*, *Eubacterium*, and *Peptostreptococcus* species, are sensitive together with anaerobic Gram-negative organisms, such as, *Bacteroides*, *Prevotella*, *Porphyromonas*, *Fusobacterium*, and *Veillonella* species. The majority of *Staphylococcus aureus* strains have developed resistance to the drug. Phenoxymethylpenicillin is commonly used by dental practitioners in the treatment of acute purulent infections, post-extraction infections, and salivary gland infections.[21,79]

The mode of activity of aminopenicillins is similar to that of phenoxymethylpenicillin, that is, inhibiting cell wall synthesis, but the former is effective against a broader spectrum of organisms, including Gram-negative organisms such as *Haemophilus* and *Proteus* species. The aminopenicillins owe their extended spectrum to an increased ability to penetrate the outer membrane of Gram-negative bacteria.[28,35]

Ampicillin is sometimes used in the empirical treatment of dento-alveolar infections when the antibiotic sensitivity patterns of the causative organisms are unknown.[21]

Amoxicillin is the drug of choice for prophylaxis of infective endocarditis,[23,80] because of its predictable and reliable absorption after oral administration rather than its increased spectrum, in patients undergoing dental treatment procedures requiring prophylaxis.[23,79] It is also common to combine some penicillins with ß-lactam inhibitory substances such as clavulanic acid, sulbactam, or tazobactam. These inhibitors block the ß-lactamase enzyme produced by the bacteria from functioning and increase the ability of the ß-lactam antibiotic to work.[23]

3.3.4.2. Cephalosporins:

Cephalosporins are bactericidal because they interfere with the synthesis of bacterial cell wall. The third generation cephalosporins are known to be more effective than penicillins against gram-negative bacilli, though they have equal effectiveness to that of penicillins against gram-positive cocci. Skin rash and anaphylactic shock are rarely seen as allergic reactions to cephalosporins.[28,36]

3.3.4.3. Metronidazole

Metronidazole was introduced in the mid-1950s by Rhone-Poulenc under the brand name Flagyl®. It was the first drug of the group that is now called nitroimidazoles. Metronidazole was first introduced as a drug in the treatment of trichomonas vaginalis, a sexually transmitted disease,[1] and it revolutionized the therapy for that condition. In 1964, a dentist noted that patients with gingivitis treated with metronidazole for trichomonas vaginalis were cured and the second major indication was then established.[1] Metronidazole was also found useful in the treatment of protozoan parasite *Giardia lamblia* and in the treatment of *Entamoeba histolytica* during the late 1960s and 1970s. In the early 1970s, it was found that metronidazole was very active against the obligate anaerobes of which the two best-

known families are *Bacteroides* and *Clostridia*.[1] Metronidazole is regarded as the gold standard for treating these infections.

The exquisite anaerobic activity of this drug makes it exceedingly effective against anaerobic bacteria. Metronidazole exerts its effect on bacteria by inhibiting microbial RNA synthesis. The drug is active against almost all strict anaerobes including *Bacteroides*, *Eubacterium*, *Fusobacterium*, and *Peptostreptococcus* species.

The drug is indicated in the treatment of acute necrotizing ulcerative gingivitis and for moderate to severe odontogenic infections, frequently in combination with penicillins.[21,79]

3.3.4.4. Tetracyclines:

Tetracyclines are broad-spectrum bacteriostatic drugs that bind to the 30S ribosomal subunit of bacteria, and specifically inhibit the binding of aminoacyl-t-RNA synthetases to the ribosomal acceptor site, thus inhibiting protein synthesis.[21] Tetracycline, doxycycline, and minocycline are the best-known members of this family of antibiotics.

In dentistry, tetracyclines are used with some success as adjunctive treatment in localized aggressive periodontitis.[21] Tetracyclines have few side effects but are not recommended for children or pregnant women because they can discolor developing teeth and alter bone growth.[81] Tetracyclines also have non-antibacterial properties that include anti-inflammatory, immunosuppressive properties, suppression of antibody production in lymphocytes, reduction in phagocytic function of polymorphonuclear leukocytes, and reduction of leukocyte and neutrophil chemotaxis. It also acts as an inhibitor of lipase and

collagenase activity, as an enhancer of gingival fibroblast cell attachment, and even has antitumor activity.[81-83]

The use of tetracycline nowadays is limited due to the increase in resistant bacterial strains and side effect of teeth staining.[28,35,36]

3.3.4.5. Macrolides and Lincosamides

The macrolide-lincosamide-streptogramin B class (MLS) antibiotics contain structurally different but functionally similar drugs. Macrolides are bacteriostatic drugs that exert their action by interfering with bacterial protein synthesis by binding to the 50S ribosomal subunit; it is thought to bind to the donor site during the translocation step.[81] Erythromycin, clarithromycin, and azithromycin are members in this family.

Macrolides have activity against *streptococci*, *staphylococci*, and some oral anaerobes.[79] Erythromycin is used instead of penicillins in penicillin-allergic patients with an added advantage of being active against ß–lactamase producing strains.[21] Clindamycin is a lincosamide and is effective against both aerobic and anaerobic species of bacteria and has a wider host range than erythromycin. It is a potent bactericidal antibiotic that exerts its action by interfering with protein synthesis. In dentistry, clindamycin has its main indication in penicillin-allergic patients who require antibiotic prophylaxis prior to dental treatments.[84]

3.3.5. Antibiotic Resistance:

Bacterial resistance to antibiotics can be defined either genotypically, where the bacteria carries certain resistance elements, phenotypically, where the bacteria can survive and grow above a certain level of antibiotics in the laboratory; or clinically, where the bacteria are able to multiply in humans in the presence of drug concentrations during therapy.[1] Bacterial resistance to antibiotics can be either natural (inherent, intrinsic) or acquired.

3.3.5.1. Natural (inherent, intrinsic) Resistance:

In this type of resistance all isolates of a certain bacterial species are not sensitive to the antibiotic in question. This could be because of a lack of certain structures in bacteria that serve as the target molecules for the antibiotic or the lack of metabolic processes essential for the activation of the antibiotic. In agreement with this, bacteria without a cell wall (e.g., the Mycoplasma species) are naturally resistant to antibiotics such as ß–lactam antibiotics, having activity against the cell wall. Another example of natural resistance is in the case of *enterococci* and *cephalosporins*.

3.3.5.2. Acquired Resistance:

In contrast to natural resistance, acquired resistance is found only in some isolates of a certain bacterial species. However, sometimes the percentage of resistant isolates could reach high figures and susceptible isolates are hardly found. Acquired resistance in bacteria is evolved because of genetic alteration that can be achieved by two mechanisms: chromosomal mutation in the preexisting bacterial genome or, most frequently, by horizontal gene transfer between bacteria both within and outside species.

Chapter Four: Materials and Methods

4.1. Sample and Setting of The Study:

All dental clinics that were open at time of the study in Irbid city in the north of Jordan were visited. The researcher invited dentist to participate in the study. Just 148 (85%) of 174 dentists, agreed to participate in this study. Only 134 returned it complete (77%).

4.2. Questionnaire and Study Parameters:

A questionnaire (Appendix) was developed by the researcher for gathering information regarding antibiotic prescription by dentists. The questionnaire was comparable to the one used by Salako *et al.* (2004) [9]. The investigator distributes the questionnaire to 5 dentists and checks its validity and the ease of understanding of its contents.

The questionnaire included six parts: socio-demographics, some clinical signs that might imply the use of antibiotics, non-clinical criteria for which respondents may give antibiotics, some dental problem treated by the dentists, occurrence of systemic diseases that might imply the use of antibiotics, and the last part concerned about endocarditis.

Demographic data included age, gender, and country of certification, year of graduation, study period, specialization, and place of graduation, average monthly income and number of working hours. Clinical signs that might imply the use of antibiotics faced by the dentist included pyrexia, gross diffuse swelling, localized fluctuant swelling, difficulty in opening mouth, difficulty in swallowing and periorbital swelling. Non-clinical criteria for which

respondents may give antibiotics included various possibilities of why dentists may give antibiotics for non-clinical reasons. Dental problems treated by the dentists included acute pulpitis, acute peripheral infection either before or after drainage, chronic marginal gingivitis, acute ulcerative gingivitis, periodontal abscess, chronic apical infection, cellulites, pericoronitis, chronic periodontitis, sinusitis, dry socket, trismus, routine extraction, surgical extraction, third molar extraction, apicectomy, conventional root canal treatment, root canal surgery preoperative, root canal surgery postoperative, scaling and polishing, restorative treatment, reimplantation of teeth, gingivictomy and aphthous ulcers.

Conditions that might imply the use of antibiotics included diabetes mellitus, hypertension, immunopathy, pace-maker, artificial heart valve, myocardial infraction, hyper- and hypo-thyroidism, epilepsy, bleeding disorders and patients allergy to penicillin. The last part is concerned about prophylaxis in endocarditis cases.

Questionnaire forms were handed to each dentist. The response rate was 85% (148/174).

4.3. Statistical analysis:

A personal computer was used for entering the data. The analysis of data was carried out using Statistical Package for Social Science (SPSS) computer software (SPSS 13.0, Inc., Chicago, USA). Frequencies and distributions were calculated. Cross-tabulations statistical test was used to analyze questioner data. The statistical significance was considered ($p < .05$)

Chapter Five: Results

5.1. Response Rate:

The questioner was sent to 174 dentists in North Jordan. 148 (85%) dentists returned the questionnaire. The inclusion criteria was using the almost fully completed questioner data. The included questioners were 134 (77%).

5.2. Participants' Characteristics:

All respondents in this study were Jordanian dentists working in private sector of dental clinics at down town of Irbid city. Out of the 134 respondents, 101 (75.4%) were males and 33 (24.6%) were females dentists. About 47% of respondents aged 30 years old and younger. Most of the participants were general dental practitioners with percentage of 79.1%. Around 70% of the respondents treat less than 16 patients per day. 67.4% of the respondents had never taken any course in antibiotics. About 60% of the respondents were graduated from countries other than Jordan. Table 5.1 shows summary of the sciodemographic and professional characteristics of the participants.

Table 5.1: Sociodemographic and professional characteristics of parliaments.

Variable	n (%)
Gender	
Male	101 (75.4)
Female	33 (24.6)
Age (year)	
≤ 30	63 (47.0)
31-40	40 (29.9)
> 40	25 (18.7)
Specialization	
Not Specialized	106 (79.1)
Specialized	28 (20.9)
Average number of daily treated patients	
≤ 15	91 (67.9)
> 15	43 (32.1)
Average monthly income	
< 600	82 (66.7)
≥ 600	41 (33.3)
Place of graduation	
Jordan	54 (40.3)
Other	80 (59.7)

5.3. Referral and Antibiotic Prescription in Specific Clinical Features:

The pattern of referral and antibiotic use for specific clinical features by participants are shown in Table 5.2. Most of respondents (89.1%) were give antimicrobial agents for gross diffuse swelling, and then localized fluctuant swelling with percentage of (73.2%). The most cases to be referred to specialist were periorbital swelling and difficulty in swallowing, (81.5% and 75.4% respectively).

Table 5.2: Pattern of referral of patients with specific clinical features to specialists and pattern of antibiotic use by participants.

Clinical features	Refer to specialist		Prescribe antibiotic	
	N*	n (%)	N*	n (%)
Gross diffuse swelling	131	71 (54.2)	101	90 (89.1)
Localized fluctuant swelling	132	20 (15.2)	123	90 (73.2)
Periorbital swelling	130	106 (81.5)	66	48 (72.7)
Pyrexia (fever) of dental origin	125	61 (48.8)	100	64 (64.0)
Difficulty in opening mouth	127	70 (55.1)	86	51 (59.3)
Difficulty in swallowing	130	98 (75.4)	66	37 (56.1)

*For dentists who prescribe antibiotic, they might also refer the patient to specialist.

5.4. Antibiotic Prescription for Selected Dental and Oral Conditions:

Table 5.3 shows the use of antibiotics for selected dental and oral conditions by participants. The majorities of respondents were give antibiotics for cellulites, surgical extraction and ANUG (93.6%, 86.4%, and 81.3% respectively). In addition, the majority of participants do not prescribe antibiotics in restorative treatments, scalling and polishing, and aphthus ulcers (1.5%, 3.0%, and 6.9% respectively)

Table 5.3: Use of antibiotics for selected dental and oral conditions by Jordanian dentists.

Dental disease	N	Yes	
		n (%)	%
Restorative treatment	133	2	1.5
Scaling and polishing	133	4	3
Aphthous ulcers	131	9	6.9
Conventional root canal treatment	130	15	11.5
Routine extraction	134	16	11.9
Acute Pulpitis	134	31	23.1
Trismus	126	40	31.7
Chronic marginal gingivitis	134	41	30.6
Root canal surgery (Pre-operative)	116	44	37.9
Chronic apical infection	129	44	34.1
Chronic periodontitis	132	48	36.4
Gingivectomy	115	55	47.8
Dry Socket	131	67	51.1
Acute periapical infection (Before drainage)	126	71	56.3
Third molar extraction	130	71	54.6
Root canal surgery (Postoperative)	116	73	62.9
Apicectomy	114	83	72.8
Acute periapical infection (After drainage)	129	88	68.2
Reimplantation of teeth	126	90	71.4
Pericoronitis	128	90	70.3
Sinusitis	115	93	80.9
Periodontal abscess	129	102	79.1
Acute ulcerative gingivitis	128	104	81.3
Surgical extraction	132	114	86.4
Cellulites	125	117	93.6

5.5. Referral and Prophylactic Antibiotic Prescription for Specific Medical Conditions:

Pattern of referrals and prescribing antibiotics among dental practitioners for clinical status are shown in Table 9. A low percentage of dentists refer dental patients if they are diabetic or hypertensive. About one third of them refer patients if they have pacemaker or myocardial infraction and lower than one third refer patients if they are immuno-compromized, have artificial heart valve, have hyperthyroidism or hypothyroidism and epilepsy. The highest rate of referral was when patient has bleeding disorders.

Out of 111 of practitioners, 109 (98.2%) would prescribe antibiotics for patients having the artificial heart valve, patients suffering of hypothyroidism. About 97 (90.7%) of 107 practitioners would prescribe antibiotics to people with immunity suppressed.

Table 5.4: Pattern of referral of patients and pattern of antibiotic use for dental patients because of their medical conditions by participants.

Clinical Status	Refer to specialist		Prescribe antibiotics	
	N	n (%)	N	n (%)
Hypertension	126	15 (11.9)	120	26 (21.7)
Diabetes Mellitus	126	17 (13.5)	122	99 (81.1)
Hyperthyroidism	123	33 (26.8)	100	19 (19.0)
Hypothyroidism	124	34 (27.4)	102	21 (20.6)
Epilepsy	126	33 (26.2)	105	12 (11.4)
Immuno-compromised	124	36 (29.0)	107	97 (90.7)
Artificial heart valve	127	36 (28.3)	111	109 (98.2)
Pace maker	125	40 (32.0)	95	56 (58.9)
Myocardial Infarction	127	41 (32.3)	102	69 (67.6)
Bleeding disorders	127	49 (38.6)	95	40 (42.1)

The non-clincal factors influencing antibiotic prescribing are shown in table 10. A high percentage (88.0%) of dentists prescribes antibiotics to prevent unexpected post-operative complications. About half of dentists prescribe antibiotics when they are uncertain of diagnosis or upon the request of the patient. About one third prescribe antibiotics, when there is no need to do so, because of time pressure and length of procedure.

Table 5.5: Reasons for prescribing antibiotics for dental patients by Jordanian dentists when there is no indication for antibiotic use.

Clinical Status	N	Yes
		n (%)
Pressure from medical representatives	125	22 (17.6)
Socioeconomic status of the patient	126	42 (33.3)
Pressure of time	127	43 (33.9)
Time of the procedure	127	44 (34.6)
Patient request for antibiotics	128	60 (46.9)
Uncertain diagnosis	127	61 (48.0)
Prevention of expected post operative complication	125	110 (88.0)

The results of this study indicated that most dentists (92.2%) would prescribe antibiotics as prophylaxis for endocarditis. However, 7.8% of them would not consider prescribing antibiotics as prophylaxis for endocarditis.

Table 5.6 shows the antibiotics usage by dental practitioners for different clinical conditions. It can be seen clearly that amoxicillin is the widest-used antibiotic for such conditions. Amoxicillin is prescribed by one third to more than half of the dentists for pyrexia, gross diffuse swelling, localized fluctuant swelling, difficulty in opening mouth, difficulty in swallowing and periorbital swelling, respectively. Metronidazole comes second and is prescribed by around fifth to a quarter of dentists for pyrexia, gross diffuse

swelling, localized fluctuant swelling, difficulty in opening mouth, difficulty in swallowing and periorbital swelling, respectively. Other antibiotics prescribed commonly for these clinical conditions include Clindamycin, Lincomycin, Penicillin-V, and others.

Table 5.6: Antibiotics usage by dental practitioners for different clinical conditions.

Clinical condition	n (%)
Pyrexia (fever) (n=75)	
Amoxicillin	38 (50.7)
Metronidazole	14 (18.7)
Amoxicillin + Metronidazole*	11 (14.7)
Clindamycin	2 (4.0)
Lincomycin	2 (4.0)
Penicillin	6 (8.0)
Others	11 (14.7)
Gross diffuse swelling (n=125)	
Amoxicillin	41 (32.8)
Metronidazole	32 (25.6)
Amoxicillin + Metronidazole*	22 (17.6)
Clindamycin	13 (10.4)
Lincomycin	7 (5.6)
Penicillin	5 (4.0)
Others	27 (21.6)
Localized fluctuant swelling (n=125)	
Amoxicillin	48 (38.4)
Metronidazole	29 (23.2)
Amoxicillin+ Metronidazole*	13 (10.4)
Clindamycin	12 (9.6)
Lincomycin	8 (6.4)
Penicillin	8 (6.4)
Others	20 (16.0)
Difficulty in opening mouth (n=54)	
Amoxicillin	19 (35.2)
Metronidazole	12 (22.2)
Amoxicillin+ Metronidazole*	4 (7.4)
Clindamycin	3 (5.6)
Lincomycin	5 (9.3)
Penicillin	3 (5.6)
Others	12 (22.2)
Difficulty in swallowing (n=44)	
Amoxicillin	19 (45.2)

Clinical condition	n (%)
Metronidazole	7 (16.7)
Amoxicillin+ Metronidazole*	4 (9.1)
Clindamycin	2 (4.8)
Lincomycin	1 (2.4)
Penicillin	5 (11.9)
Others	8 (19.0)
Periorbital swelling (n=55)	
Amoxicillin	15 (27.3)
Metronidazole	14 (25.5)
Amoxicillin+ Metronidazole*	9 (16.4)
Clindamycin	10 (18.2)
Lincomycin	4 (7.3)
Penicillin	3 (5.6)
Others	13 (23.6)

[a] Combinations are not included in the total but indicate the existence of the two choices by the same respondents.

Antibiotic usage by dental practitioners for different dental conditions is presented in the Table 5.7. Amoxicillin and Metronidazole again are the most common antibiotics prescribed by dentists for the dental procedures. Other antibiotics prescribed for these cases also prescribed less frequently by dentists.

Table 5.7: Antibiotics usage by dental practitioners for different dental conditions.

Dental condition	n (%)
Acute Pulpitis (n=34)	
Amoxicillin	16 (47.1)
Metronidazole	7 (20.6)
Amoxicillin+ Metronidazole*	3 (8.8)
Clindamycin	3 (8.8)
Lincomycin	1 (2.9)
Others	7 (20.6)
Acute periapical infection before drainage (n=87)	
Amoxicillin	28 (32.2)
Metronidazole	20 (23.0)
Amoxicillin+ Metronidazole*	13 (14.9)
Clindamycin	11 (12.6)
Lincomycin	2 (2.3)
Penicillin	7 (8.0)
Others	19 (21.8)

Dental condition	n (%)
Acute periapical infection after drainage (n=114)	
Amoxicillin	34 (29.8)
Metronidazole	30 (26.3)
Amoxicillin+ Metronidazole*	16 (14.0)
Clindamycin	12 (10.6)
Lincomycin	7 (6.2)
Penicillin	10 (8.8)
Others	21 (18.4)
Chronic marginal gingivitis (n=54)	
Amoxicillin	7 (13.0)
Metronidazole	21 (38.9)
Amoxicillin+ Metronidazole*	5 (9.3)
Rodogyl	8 (14.8)
Sulfonamides	6 (11.1)
Tetracyclines	5 (9.3)
Others	7 (13.0)
Acute ulcerative gingivitis (n=122)	
Amoxicillin	24 (19.7)
Metronidazole	48 (39.3)
Amoxicillin+ Metronidazole*	12 (9.8)
Rodogyl	12 (9.8)
Penicillin-V+Pencillin-G	6 (4.9)
Tetracyclines	15 (12.3)
Others	17 (13.9)
Periodontal abscess (n=127)	
Amoxicillin	35 (27.6)
Metronidazole	40 (31.5)
Amoxicillin+ Metronidazole*	16 (12.6)
Penicillin	6 (4.7)
Tetracyclines	12 (9.4)
Clindamycin	9 (7.1)
Lincomycin	5 (3.9)
Others	20 (15.7)
Chronic apical infection (n=47)	
Amoxicillin	16 (34.0)
Metronidazole	14 (29.8)
Amoxicillin+ Metronidazole*	10 (21.3)
Clindamycin	8 (17.0)
Lincomycin	5 (10.6)
Penicillin	3 (6.4)
Others	6 (12.8)
Cellulites (n=135)	
Amoxicillin	41 (30.4)
Metronidazole	29 (21.5)

Dental condition	n (%)
Amoxicillin+ Metronidazole*	16 (11.9)
Clindamycin	12 (8.8)
Lincomycin	6 (4.4)
Penicillin	16 (11.9)
Augmuntin	13 (9.6)
Others	18 (13.3)
Pericoronitis (n=98)	
Amoxicillin	37 (37.8)
Metronidazole	26 (26.5)
Amoxicillin+ Metronidazole*	3 (3.1)
Cephalosporin 1st	7 (7.1)
Clindamycin	4 (4.1)
Lincomycin	2 (2.0)
Penicillin	6 (6.1)
Others	16 (16.3)
Chronic periodontitis (n=56)	
Amoxicillin	13 (23.2)
Metronidazole	21 (37.5)
Amoxicillin+ Metronidazole*	8 (14.3)
Rodogyl	4 (7.1)
Others	18 (32.1)
Sinusitis (n=92)	
Amoxicillin	26 (28.3)
Augmuntin	12 (13.0)
Amoxicillin+ Metronidazole*	4 (4.3)
Penicillin	9 (9.8)
Cephalosporin 1st	10 (10.9)
Metronidazole	9 (9.8)
Others	26 (28.3)
Dry Socket (n=71)	
Amoxicillin	24 (33.8)
Metronidazole	17 (23.9)
Amoxicillin+ Metronidazole*	9 (12.7)
Clindamycin	6 (8.6)
Lincomycin	11 (15.5)
Others	13 (18.3)
Trismus (n=41)	
Amoxicillin	18 (43.9)
Metronidazole	11 (26.8)
Amoxicillin+ Metronidazole*	6 (14.6)
Clindamycin	3 (7.3)
Lincomycin	2 (4.9)
Others	7 (17.1)
Routine extraction (n=17)	

Dental condition	**n (%)**
Amoxicillin	8 (47.1)
Metronidazole	4 (23.5)
Penicillin	3 (17.6)
Others	3 (17.6)
Surgical extraction (n=129)	
Amoxicillin	64 (49.6)
Metronidazole	24 (18.6)
Amoxicillin+ Metronidazole*	16 (12.4)
Clindamycin	4 (3.1)
Lincomycin	9 (7.0)
Penicillin	7 (5.4)
Others	21 (16.3)
Third molar extraction (n=78)	
Amoxicillin	38 (8.7)
Metronidazole	22 (28.2)
Amoxicillin+ Metronidazole*	12 (15.4)
Clindamycin	3 (3.5)
Lincomycin	4 (5.1)
Cephalosporin 1st	7 (9.0)
Others	4 (5.1)
Apicectomy (n=88)	
Amoxicillin	36 (40.9)
Metronidazole	18 (20.5)
Amoxicillin+ Metronidazole*	13 (14.8)
Clindamycin	6 (6.8)
Lincomycin	6 (6.8)
Penicillin	9 (10.2)
Cephalosporin 1st	4 (4.5)
Others	9 (10.2)
Conventional root canal treatment (n=14)	
Amoxicillin	5 (35.7)
Metronidazole	4 (28.6)
Amoxicillin+ Metronidazole*	2 (14.3)
Lincomycin	2 (14.3)
Penicillin	2 (14.3)
Rodogyl	1 (7.1)
Root canal surgery pre-operative (n=44)	
Amoxicillin	14 (31.8)
Metronidazole	15 (34.1)
Amoxicillin+ Metronidazole*	9 (20.5)
Clindamycin	1 (2.3)
Lincomycin	2 (4.5)
Penicillin	4 (9.1)
Cephalosporin 1st	4 (9.1)

Dental condition	n (%)
Others	4 (9.1)
Root canal surgery postoperative (n=74)	
Amoxicillin	28 (37.8)
Metronidazole	16 (21.6)
Amoxicillin+ Metronidazole*	11 (14.9)
Clindamycin	4 (5.4)
Lincomycin	6 (8.1)
Penicillin	6 (8.1)
Rodogyl	5 (6.8)
Others	9 (12.2)
Scaling and polishing (n=6)	
Amoxicillin	2 (33.3)
Metronidazole	3 (50.0)
Tetracyclines	1 (16.7)
Others	2 (33.3)
Restorative treatment (n=0)	
Reimplantation of teeth (n=95)	
Amoxicillin	53 (55.8)
Metronidazole	13 (13.7)
Amoxicillin+ Metronidazole*	6 (6.3)
Clindamycin	4 (4.2)
Lincomycin	3 (3.2)
Penicillin	5 (5.3)
Others	17 (17.9)
Gingivectomy (n=57)	
Amoxicillin	19 (33.3)
Metronidazole	16 (28.1)
Amoxicillin+ Metronidazole*	4 (7.0)
Clindamycin	3 (5.3)
Lincomycin	2 (3.5)
Rodogyl	4 (7.0)
Others	13 (22.8)
Aphthous ulcers (n=10)	
Amoxicillin	5 (50.0)
Metronidazole	2 (20.0)
Clindamycin	1 (10.0)
Lincomycin	1 (10.0)
Solcosyerl	1 (10.0)

[a] These combinations are not included in the total but indicate the existence of the two choices by the same respondents.

Erythromycin is the most preferred antibiotic 86.7% when the patient is allergic to penicillinin. Clindamycin is the second choice with 50.8%.

Table 5.8: Preferences for usage of antibiotics when the patient is allergic to penicillin among dental practitioners.

Antibiotic	**n (%)**
Erythromycin	111 (86.7)
Clindamycin	65 (50.8)
Cephalosporin 1st	34 (26.6)
Lincomycin	29 (22.7)
Tetracyclines	29 (22.7)
Clarithromycin	11 (8.6)
Metronidazole	10 (7.8)
Azethromycin	10 (7.8)
Gentamycin	5 (3.9)
Ciprofloxacin	5 (3.9)
Ampicillin	4 (3.1)
Balkatrin	3 (2.3)
Spiramycin	2 (1.6)
Cephalosporin 2nd	2 (1.6)
Vancomycin	1 (0.8)

Percent pattern of antibiotic prescription for endocariditis by dental practitioners is shown in Table 14. Out of 248 valid answers to this item, for artificial heart valve 59 (23.8), history of previous of infective endocarditis 28 (11.3), myocardial infraction 23 (9.3)

Table 14: Percent pattern of antibiotic prescription for endocariditis cases by dental practitioners.

Disease	**n (%)**
Artificial heart valve	59 (23.8)
History of previous of infective endocarditis	28 (11.3)
Myocardial infraction	23 (9.3)
Pace maker	17 (6.9)
Mitral valve with regurgation or thickned valves	15 (6.0)
Congenital cardiac myopathy	14 (5.6)
History of heart problem	14 (5.6)
Immunocompromised	10 (4.0)
History of valvular disease (e.g rheumatic fever)	9 (3.6)
Diabetes mellitus	8 (3.2)
Artirial septal defect	6 (2.4)
Congintal cyanotic heart defect (Falloti tetralogy)	6 (2.4)
Patient with major heart surgery (open heart surgery)	6 (2.4)
Ststemic pulmonary shunt	5 (2.0)
Ventricular septal defect	4 (1.6)
Angina pectoris	3 (1.2)
Congenital Aeortic Disease	3 (1.2)
Congenital heart valve problem	3 (1.2)
Stent	3 (1.2)
Atherosclorosis	2 (0.8)
Catheter	2 (0.8)
Coronary artery bypass graft (CABG)	1 (0.4)
Ductus arterisus	1 (0.4)
Kidney transplant	1 (0.4)
Knee infection	1 (0.4)
Leukemia	1 (0.4)
People with dialysis	1 (0.4)
Prosthetic joint	1 (0.4)
Surgical repaired cardiac defect within 6 months	1 (0.4)
Total	**248 (100)**

Chapter Six: Discussion

Antibiotics are invaluable adjuncts in the management of orofacial infections. Although they are not a substitute for definitive treatment, their judicious use can shorten infection periods and minimize associated risks, such as the spread of infection to adjacent anatomical spaces or systemic involvement.[85]

Increasing microbial resistance to antibiotics, however, is a well-documented and serious global health concern.[71,86,87] First observed in 1940, penicillin-resistant bacteria were overcome with the development of new antibiotics.[88] The emergence of new multidrug–resistant bacteria, however, has escalated at an alarming rate. One factor that may contribute is inappropriate use of antibiotics in dentistry.[86,88] Dentistry's contribution to the development of antimicrobial resistance is unknown.[88] However, Zadik and Levin (2008)[89] found that overmedication of the antibiotics among young practitioners.

Therefore, we conducted a survey to assess the therapeutic and prophylactic prescription of antibiotics in dental practice.

Generally there is a lack of information about the use of antibiotic drugs in dental practice in Jordan, especially in the North Irbid. This study investigates the use of antibiotics in dental practice in Irbid. And it's a first of its kind in Jordan.

6.1. Participants' Characteristics:

About half of dental practitioners who participated in the study (n=134) were 30 years old or younger. Only 20.9% of them were specialized. Specialization, thus, does not appear to be the major concern of dental practitioners, especially taking into consideration that two thirds of them have an income level of less than 600 JDs per month, which means that they might not be able to afford the costs of specialization.

It is also noteworthy that more than two thirds of them have never taken any course in antibiotics, meaning that their proper knowledge in antibiotic prescription might be drawn from experience or was a matter of trial and error, although they might get their information for antibiotic suitability for some diseases from contact with drug dealers and medical representatives.

Just more than 40% of the respondents have graduated from Jordanian collages, while the rest of them (59.7%) have graduated from countries other than Jordan, this indicates that the lack in curricula for antibiotic courses for dentistry students is not found only in Jordanian schools of dentistry. But also in other countries these dentists have graduated from.

6.2. Referral to Specialist in Specific Clinical Features:

Referring a patient who exhibits pyrexia (generalized fever) to a specialist was common among about 40% of the dental practitioners. More than half of the respondents would refer patients with gross diffuse swelling to a specialist for treatment. With regard to the localized fluctuant swelling, less than one fifth of respondents would refer the patient to a specialist. About 55.1% of respondents would refer the patient to specialist for difficulty in

opening mouth, for the difficulty in swallowing and periorbital swelling, three quarters and four fifths of the respondents would refer the patient to specialist, respectively.

6.3. Antibiotic Prescription in Specific Clinical Features:

Sixty-four of 100 of the respondents would prescribe antibiotic for pyrexia. The rate of antibiotic prescription for pyrexia is higher than can be anticipated since mild pyrexia does not imply prescription of antibiotics unless the patient is proven infected with bacteria. In addition, the dentist may not be able to differentially diagnose pyrexia of bacterial or viral origin. With the high rate of practitioners who prescribe antibiotics for pyrexia, it can be seen that practitioners are prescribing antibiotics to clients with elevated temperature irrespective of their clinical status. While these patients may need to be administered antibiotics, dentist should consult the patient physician in such cases.[90] In some cases, though, laboratory examination would be a useful tool to verify systemic involvement, where, antibiotic treatment would be essential. Thus, in terms of pyrexia, the patient should not be given any antibiotic unless identified infected post-operatively.

Around ninety (89.1%) of respondents would prescribe antibiotics for gross diffuse swelling. However, similar to pyrexia, the dentist should refer the client to his/her physician to rule out systemic involvement. The most common treatment indicated for swelling and abscesses is to probe them to drain in aseptic oral environment, as mentioned earlier; some studies indicated that the pre-operative antibiotic treatment in such cases does not yield any significant outcomes rather than the choice of no antibiotic treatment. Localized fluctuant swelling cases should also not be treated with antibiotic. Rather, treatment includes similar procedures to the gross diffuse swelling. In both types of

swelling the patient should be instructed to apply a saline water wash every 2 hours. About 73.2% of 123 respondents would prescribe antibiotics for localized fluctuant swelling, meaning that they are prescribing antibiotics for these cases in a rate higher than can be anticipated. Antibiotic usage in such a case should be following consulting the physician and/or laboratory findings of systemic involvement. However, according to the ADA guidelines for antibiotic prescription for dental cases, some cases should be given antibiotic treatment.

For difficulty in opening mouth 51 (59.3%) of 86 respondents would prescribe antibiotics. Of the 66 of respondents, 37 (56.1%) and 48 (72.7%) would prescribe antibiotics for patients with difficulty in swallowing and periorbital swelling. However, scaling and other established emergency techniques should be applied here not antibiotics, unless the lymph nodes are palpable. Which means that a high percent of dentists in our study do give antibiotics to people with difficulty in opening mouth and periorbital swelling.

6.4. Antibiotic Prescription for Selected Dental and Oral Conditions:

Of the 134 respondents, 31 (23.1%), 41 (30.6%) and 16 (11.9%) would prescribe antibiotics for acute pulpitis, chronic marginal gingivitis and routine extraction, respectively. In case of, Necrotizing Ulcerative Gingivitis (NUG) procedure of treatment could follow the emergency treatment guidelines, which is something these portions of practitioners do not commit to; however, they would rather prescribe antibiotics, which are not feasible in such cases, unless systemic signs of infection are observable.

Unless there is a systemic involvement, management of uncomplicated periapical abscesses is effective drainage and removal of the cause. However, about 56.3% would

prescribe antibiotics for acute periapical infection before drainage. In some situations where drainage or removable of the cause may not be feasible immediately, especially when there is an evidence of systemic involvement, antibiotic use can be instituted to prevent or limit local and metastatic infection.

About one third of those surveyed would prescribe antibiotics for trismus, with amoxicillin and metronidazole being the antibiotics of choice Table 5.7, among 43.9% and 26.8% of them were correctly prescribing amoxicillin and metronidazole, respectively.

Antibiotic prescription among practitioners for cases of acute periapical infection after drainage, periodontal abscess, and chronic apical infection was evident among 68.2%, 79.1%, and 34.1% of practitioners, respectively. Although, in the majority of uncomplicated infected swellings, drainage of an infection is the only treatment necessary. These percentages indicate an evident high rate of non-indicated use of antibiotics among them.

Acute ulcerative gingivitis and pericoronitis cases were prescribed antibiotics in 81.3% and 70.3%, respectively. These percentages were almost similar to those reported earlier (65.5% and 72.6%, respectively) among GDPs in Kuwait,[9] and were less than those reported by Palmer among GDPs in England.[37] However, while the large percent of practitioners (81.3%) correctly prescribe antibiotics (amoxicillin and metronidazole, Table 5.7 for acute ulcerative gingivitis, the antibiotic prescription for pericoronitis is only indicated for largely spreading infections or systemic involvement.[37] Otherwise, it can be effectively treated by local measures.[37]

Correctly prescribing antibiotics for cellulites is evident among 93.6% of practitioners, with the antibiotic of choice being amoxicillin and metronidazole Table 5.7. These results are in accordance with those reported earlier among GDPs in England, and Kuwait.[9,37]

The proportion of practitioners correctly prescribing antibiotics for chronic periodontitis Table 5.3 was higher than that reported among Kuwaiti GDPs [9] and that reported among GDPs in England.[37] The antibiotics of choice for this case are amoxicillin and metronidazole Table 5.7. However, a clearly effective antibiotic use for treatment of these cases is still under investigation.

About 86.4% of responding practitioners prescribe antibiotics for cases that undergo surgical extraction, with amoxicillin and metronidazole being the antibiotics of choice. However, earlier reports regarding surgical wound infections following extraction procedures were non-supportive for such use of antibiotics, as less than 3% of cases of surgical extraction develop infection. The incidence of infection due to surgical extraction is low enough to exclude the need for antibiotic prescription.[9] Zadik and Levin (2008)[89] found that 46 percent of participants routinely prescribed antibiotics after third molar surgery.

Sinusitis treatment with antibiotics is still in debate. Although 80.9% of surveyed practitioners prescribe antibiotics for patients with sinusitis, with the drugs in choice being amoxicillin and agumuntin Table 5.7, the effectiveness of antibiotics in treating sinusitis is questionable, and recent reports indicated that antibiotic treatment does not have any effects on the course of the disease.[37]

Gingivectomy cases do not require antibiotic treatment unless systemic involvement is evident. However, about 47.8% practitioners prescribe antibiotics for such cases, with amoxicillin and metronidazole being the drug of choice.

Dry socket is a condition that develops after extraction of the third molar.[9] About 51.1% of surveyed practitioners prescribe antibiotics for this case. However, with improved aseptic conditions, and non-advantageous use of prophylactic antibiotics reported by Rud (1970)[91]. The prescription of antibiotics for such cases is not necessary.

Topical and systemic antibiotic treatments are empiric and are used because of a belief that some as-yet-undiscovered infectious agent is causing the aphthous ulcer.[92] About 6.9% of surveyed practitioners would prescribe antibiotics for this condition. The antibiotics of choice for this case were amoxicillin and metronidazole Table 5.7.

In cases of apicectomy 72.8% of practitioners would prescribe antibiotics, with amoxicillin and metronidazole being the antibiotics of choice. As mentioned earlier, apicectomies do not require antibiotic prescription unless systemic involvement or gross infection is evident.[9]

Pre- and post-operative antibiotic prescription for root canal surgery among practitioners (37.9% and 62.9%, respectively) was higher than that reported earlier among Kuwaiti GDPs,[9] despite the fact that the procedure does not require antibiotic prescription. For the same reason, 54.6% practitioners would unnecessarily prescribe antibiotics to patients undergoing third molar extraction, 11.5% for patients undergoing conventional root canal treatment.

Only 3% and 1.5% of surveyed practitioners would prescribe antibiotics for patients undergoing scaling and polishing and restorative treatment, respectively. These incidents of antibiotic prescription of scaling and polishing and restorative treatment are low, and are in accordance with the fact that these procedures do not require antibiotic administration in the first place.[9]

6.5. Referral and Prophylactic Antibiotic Prescription for Specific Medical Conditions:

Percentage pattern of referrals and prescribing antibiotics among dental practitioners for clinical status are shown in Table 5.4. A low percentage of dentists refer dental patients if they are diabetic or hypertensive. However, dentists can reduce the morbidity and mortality associated with diabetes by maintaining their patients' oral health and by referring patients with signs and symptoms of oral complications suggestive of diabetes to physicians for further evaluation.[93]

About one third of practitioners refer patients if they have pacemaker or myocardial infraction and lower than one third refer patients if they are immuno-compromized, have artificial heart valve, have hyperthyroidism or hypothyroidism and epilepsy. The highest rate of referral was when patient has bleeding disorders.

About 19% of surveyed practitioners would prescribe antibiotics for patients with hyperthyroidism, 20.6% would prescribe them for patients suffering of hypothyroidism. Such percent is considered low and this is meant to be promising since antibiotics are not indicated to such type of patients.

For immuno-compromised patients, 90.7% of practitioners would prescribe antibiotics. These results are in accordance with the ADA guidelines and were similar to those reported by Palmer et al. (2000)[37].

More than half of practitioners would prescribe antibiotics to people having pacemaker despite the fact that antibiotic are not indicated for dental patients with implanted pace makers or defibrillators.[23]

The majority (81.1%) of practitioners would prescribe antibiotics for people affected by diabetes mellitus and 21.7% would prescribe them to hypertensive people. Although diabetic patients may require prophylaxis when they suffer from diabetes mellitus type I, people with hypertension with no cardiac compromise do not need such prophylaxis.[23,94]

For epileptic cases, 11.4% practitioners prescribe antibiotics, while there is no need for antibiotic prophylaxis as indicated by recommendations of ADA. In addition, 98.2% dental practitioners correctly prescribe antibiotics to patients having the artificial heart valve, 67.6% prescribe them to patients with myocardial infraction, and 42.1% prescribe them to patients suffering bleeding disorders Table 5.4. Antibiotic prescription for cases of artificial heart valves and bleeding disorders is recommended for patients at risk, however, these recommendations are now updated so that only patients at high risk should be prescribed antibiotics by their dentists.[23,94]

Preventive use of antibiotics has often been recommended for patients who have certain pre-existing heart conditions or compromised immune systems. New guidelines drafted

jointly by the American Heart Association (AHA) and the American Dental Association (ADA) recommend dentists do not routinely prescribe antibiotics to prevent infective endocarditis in all patients with heart conditions. Only patients at the greatest risk of negative outcomes of IE should take antibiotics before dental procedures. These include heart transplant patients who develop cardiac valve problems, people with artificial heart valves, people with certain congenital heart conditions, and anyone with a history of infective endocarditis.[23,94]

A high percentage (88.0%) of dentists prescribes antibiotics when it is not indicated as attempt to prevent unexpected post-operative complications. About half of dentists prescribe antibiotics when they are uncertain of diagnosis or upon the request of the patient. About one third prescribe antibiotics, when there is no need to do so, because of time pressure and length of procedure. These percentages are higher than those reported by Palmer et al. (2000)[37]. The most significant irrational decision we found in the results is that about half of the practitioners would prescribe antibiotics according to patient preference. This high proportion was not found in either England or Kuwait.[9,37]

The results of this study indicated that most dentists (92.2%) would prescribe antibiotics as prophylaxis for endocarditis. However, 7.8% of them would not consider prescribing antibiotics as prophylaxis for endocarditis. Several studies audited the use of prophylactic antibiotic for endocarditis.[9,23,37,94] Updates included that only patients with dental procedures that might cause systemic involvement are indicated to antibiotic prophylaxis, and in certain cases such as vulvular heart disease, previous endocarditis, surgical pulmonary shunts, hypertrophic cardiomyopathy, prosthetic heart valves and mitral valve

prolapse, antibiotic prophylaxis is indicated as the risk of antibiotic usage is subordinated by the risks of these cases.[23,94]

The antibiotics used by dental practitioners for different clinical conditions are shown in Table 5.6. It can be seen clearly that amoxicillin and metronidazole are the widest-used antibiotic for such conditions among dental practitioners. These two antibiotics are prescribed by more than half to one third of the dentists for pyrexia, gross diffuse swelling, localized fluctuant swelling, difficulty in opening mouth, difficulty in swallowing and periorbital swelling, respectively. Metronidazole comes second after amoxicillin and is prescribed by around fifth to a quarter of dentists for pyrexia, gross diffuse swelling, localized fluctuant swelling, difficulty in opening mouth, difficulty in swallowing and periorbital swelling, respectively. Other antibiotics prescribed commonly for these clinical conditions include Clindamycin, Lincomycin, Penicillin-V, and others, these results are similar to those reported earlier in Kuwait and England, and are in accordance with the ADA recommendations.[9,23,37,94]

Antibiotic usage by dental practitioners for different dental conditions is presented in Table 5.7. Amoxicillin and Metronidazole are the most common antibiotics prescribed by dentists for acute pulpitis, acute periapical infection before drainage, acute periapical infection after drainage, chronic marginal gingivitis, acute ulcerative gingivitis, periodontal abscess, chronic apical infection, cellulites, pericoronitis, chronic periodontitis, sinusitis, dry socket, trismus, routine extraction, surgical extraction, third molar extraction, apicectomy, conventional root canal treatment, root canal surgery pre-operative, root canal surgery postoperative, scaling and polishing, reimplantation of teeth, gingivectomy, and aphthous ulcers these results are similar to those reported earlier in Kuwait and England,

and are in accordance with the ADA recommendations, [9,23,37,94] with, however, some minor differences for the need to use them according to the risk status of the patient.

Other antibiotics prescribed for these cases includes Clindamycin, Lincomycin, Penicillin V, Rodogyl, Sulfonamides and Tetracyclines, which are prescribed less frequently by dentists Table 5.7.

Table 5.8 shows dental practitioners preferences for usage of antibiotics when the patient is allergic to penicillin. Of the total 128 respondents to this item, descending order of antibiotic preference for the use when the patient is allergic to penicillin is: erythromycin, clindamycin, cephalosporin 1st generation, lincomycin, tetracyclines, clarithromycin, metronidazole, and azethromycin. These findings where in accordance to the ADA recommendations and consensus reports.[23,94]

Lockhart et al.(2007)[70] found that formal recommendations in favor of antibiotic prophylaxis with dental treatments should to be given only for three medical conditions: native heart disease, prosthetic heart valves and prosthetic joints. They also found that patients with renal dialysis shunts, cerebrospinal fluid shunts, vascular grafts, immunosuppression secondary to cancer and cancer chemotherapy, systemic lupus erythematosus, and insulin-dependent (type 1) diabetes mellitus should not to receive prophylactic antibiotics with dental treatments.

Percent pattern of antibiotic prescription for endocariditis and immuno-compromised cases by dental practitioners is shown in Table 9. For artificial heart valve (23.8%), history of previous infective endocarditis (11.3%), myocardial infraction (9.3%), pace maker (6.9%),

mitral valve with regurgation or thickned valves (6.0%), congenital cardiac myopathy 14 (5.6%), history of heart problem (5.6%), immuno-compromised clients (4.0%), history of valvular disease (e.g rheumatic fever) (3.6%), diabetes mellitus (3.2%), artirial septal defect (2.4%), congintal cyanotic heart defect (falloti tetralogy) (2.4%), patient with major heart surgery (open heart surgery) (2.4%), systemic pulmonary shunt (2.0%) and ventricular septal defect (1.6%) dentists prescribe antibiotics. However, recent evidence show that only valvular heart disease, previous endocarditis, surgical pulmonary shunts, hypertrophic cardiomyopathy, mitral valve prolapse with regurgitation, prosthetic heart valves, renal hemodialysis with arteriovenous shunts and ventriculoatrial shunts for hydrocephalus are the cases where antibiotic prophylaxis is indicated, while orthopedic prostheses more than two years in place, implanted pacemaker or defibrillator, vascular grafts, previous coronary bypass graft surgery, Ventriculoperitoneal shunts for hydrocephalus and in patients with compromised immune systems does not require antibiotic prophylaxis.[23,94] However, in the latter cases where prophylaxis is not required, some practitioners may consider antibiotic prophylaxis in deep invasive procedures or in some specific situations. Prevention of local infection in surgical sites does not require antibiotic prophylaxis, although treatment of coexistent infection is recommended before surgical procedures.[23,94]

6.6. Limitation and Strength of the study

The limitations of this study:

1. The study conducted in private sectors, so it is not represent for Jordan.
2. This study is descriptive study and no analysis were done.

The Strength of this study :

1. Sample size was large enough to compare with other studies related to it.
2. The response rate was fine and comparable with the one in Kuwait
3. This study it's first of its' kind here in Jordan.

Chapter Seven: Conclusions

Within the limitation of this study, the following conclusions can be drawn:

In this study the results have shown that prescribing of antibiotics by Jordan dentist is often not based on a defined criterion. Wide variation observed for the type of antibiotic prescribed among dentist for different cases, but amoxicillin were the most common antibiotic used.

There is a need for development of appropriate guidelines for antibiotic use.

APPENDIX

ID #: .....

QUESTIONNAIRE – USE OF ANTIBIOTICS BY DENTISTS

1. Age: .....

2. Gender:
   - ☐ Male
   - ☐ Female

3. High school: (Tawjihi)
   - ☐ Science
   - ☐ Art
   - ☐ Others: specify: ….....

4. Where did you study dentistry
   - ☐ Private dental school
   - ☐ Governmental dental school

5. Number of study years for the undergraduate:
   - ☐ Four years or less
   - ☐ Five years
   - ☐ More than five year

6. Year of graduation: .....

7. Place of graduation: .....

8. Did you have or attend any courses in using and prescribing antibiotics in daily dental practice (after graduation)?
   - ☐ No
   - ☐ Yes

9. Are you specialized?
   - ☐ No
   - ☐ Yes

   If yes specify …….....

10. Number of patient treated in your clinic daily
    - ☐ 0 – 15 patients
    - ☐ 16 – 30 patients
    - ☐ 31 – 45 patients
    - ☐ More than 45 patients

11. Average income / month
    - ☐ Less than 300 JD.
    - ☐ 300 - 600 JD.
    - ☐ 601 - 900 JD.
    - ☐ 901 - 1200 JD.
    - ☐ More than 1200 JD.

12. Working time
    - ☐ Day only
    - ☐ Night only
    - ☐ Day and Night
    - ☐ Irregular

13. What is your management in these cases?

Clinical feature	A Refer to specialist		B Did you give Antibiotics?				C What antibiotics are you prescribing?	D Dose (mg)	E Duration (Days)	F Comments
	yes	no	always	very often	rare	never				
1 Pyrexia (Fever)										
2 Gross diffuse swelling										
3 Localized fluctuant swelling										
4 Difficulty in opening mouth										
5 Difficulty in swallowing										
6 Periorbital Swelling										

14. What is your management in these cases?

Dental Status	**A**. Give Antibiotic				**B**. What antibiotics are you prescribing?	**C**. Dose (mg)	**D**. Duration (day)	**E.** Comme
	always	v. often	Rare	never				
1. Acute Pulpitis								
2. Acute periapical infection a.Before drainage								
b..After drainage								
3. Chronic marginal gingivitis								
4. Acute ulcerative gingivitis								
5. Periodontal abscess								
6. Chronic apical infection								
7. Cellulites								
8. Pericoronitis								
9. Chronic periodontitis								
10. Sinusitis								
11. Dry Socket								
12. Trismus								

Dental Status	**A**. Give Antibiotics				**B**. What antibiotics are you prescribing?	**C**. Dose (mg)	**D.** Duration (day)	**E.** Comme
	always	v. often	Rare	never				
13. Routine extraction								
14. Surgical extraction								
15. 3rd molar extraction								
16. Apicectomy								
17. Conventional RCT								
18. Root canal surgery pre-operative								
19. Root canal surgery postoperative								
20. Scaling and polishing								
21. Restorative treatment								
22. Reimplantation of teeth								
23. Gingivectomy								
24. Aphthous ulcers								

15. Did you give your patient antibiotic if he/she has one of these systemic problem or disease?

Clinical status	A. Give Antibiotic				B. Refer to specialist	C. Comments
	Always	very often	rare	never		
1. Diabetes Mellitus						
2. Hypertension						
3. Immuno - compromised						
4. Pace maker						
5. Artificial heart valve						
6. Myocardial Infarction						
7. Hyperthyroidism						
8. Hypothyroidism						
9. Epilepsy						
10. Bleeding disorders						

16. If the patient is allergic to penicillin what is the alternative antibiotics of your choice?

a. ……. b. ……. c. …….
d. ……. e. …….

17. Did you give the patient antibiotics although he Didn't need because of:	**Yes**	**Sometime**	**No**
a. pressure of time			
b. uncertain diagnosis			
c. time of the procedure			
d. socioeconomic status of the patient			
e. patient ask for that			
f. keep your relationship with medical representative			
g. prevention of post operative complication			

18. Do you use antibiotics as prophylaxis to prevent endocarditis?

a. No b. Yes

If yes, in which medical condition you give?

1. ……..
2. ……..
3. ……..
4. ……..
5. ……..

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معارف أطباء الأسنان حول المضادات الحيوية في العلاج الفموي والسني في شمال الأردن

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الملخص

المقدمة: في الآونة الأخيرة أصبح استخدام المضادات الحيوية بشكل زائد جدا في جميع مجالات الحياة بما فيها طب الأسنان. وذلك جعل الباحث يعتقد بأن هناك ضرورة لبحث مدى صحة هذا الكلام وانطابقه على أطباء الأسنان في شمال الأردن. فكان الهدف من هذه الدراسه هو تقييم نمط استخدام المضادات الحيويه من قبل اطباء الاسنان في شمال الاردن ومدى معرفتهم بالاستخدام الأمثل في العلاج الفموي والسني.

المواد والطرق: تم تحضير استبانة لهذا الغرض. وتم توزيع الاستبانة باليد إلى ١٧٤ طبيب أسنان ممارس في إربد. الاستبانة كانت تحتوي على بعض المعلومات الاجتماعية، وبعض الأعراض السريريه والغير سريرية والتي قد تنطوي على استخدام المضادات الحيويه ،وبعض الأمراض والمشاكل السنية والتي قد تستدعي استخدام المضادات الحيوية من قبل أطباء الاسنان وحدوث امراض جهازيه قد تستوجب استخدام المضادات الحيويه، والجزء الأخير خاص بالEndocarditis.

النتائج: أظهرت النتائج أن نسبة الاستجابة كانت ١٣٤ من ١٧٤ أي ٨٥% ونسبة الاستبينات المكتملة كانت ٧٧%. ثلاثة أرباع المشاركين كان من الذكور، نصفهم كانت أعمارهم أقل ٣٠ سنة. نسبة الخريجين الأردنين كانت ٤٠ %. من ضمن المشاركين في العينة ٦٤% يصفون المضادات الحيوية بسبب ارتفاع درجة حرارة المريض، بينما ٧٣% يصفونها للتورم الموضعي، و٨٩ بالمئة للأورام المختلطة. لصعوبة في فتح الفم ، ٥٩،٣ في المائة من المجيبين من شأنه ان يصف المضادات الحيوية. من المشاركين حوالي ٥٦٪ و ٧٣ ٪ من شأنه ان يصف الادوية المضاده للمرضى الذين يعانون من صعوبة في البلع وPeriorbital Swelling على التوالي. في حالة Cellulites ، والقلع الجراحي، والANUG ، والتهاب الجيوب ، والخراج المحيط بالضرس ، وApicectomy نسبة من يصف المضادات الحيوية كانت حوالي ٩٣،٦ ٪ ، ٨٦،٤ ٪ ، ٨١،٣ ٪ ، ٨٠،٩ ٪ ، ٧٩،١ ٪ ، ٧٢،٨ ٪ على التوالي. في حالة الاستخدامات الوقائيه، كانت النسبة ٩٨،٢ ٪ لمرضى صمام القلب الاصطناعي ، و ٨٨ ٪ للحيلولة دون ضهور المضاعفات ما بعد الاستطبابات الروتينية والسريرية المختلفة. ومن ضمن النتائج أيضا كان ال Amoxicillin هو المضاد الحيوي الاكثر شيوعا من قبل أطباء الأسنان في إربد.

الإستنتاجات: المضادات الحيوية تستخدم على نطاق واسع في الاستطبابات الروتينيه في علاج الاسنان. وهناك نقص في المعلومات عن الاستخدام الأمثل لوصفات المضادات الحيوية.